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# TECH SOLUTIONS 508.2 Ballast Design Guide for PMR Systems

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## INTRODUCTION

This document has been developed for those who design, specify, or install protected membrane roof (PMR) systems to assist in the selection of job-specific stone and/or paver ballast design. PMR assemblies place STYROFOAM™ Brand Extruded Polystyrene Insulation above the roofing membrane, protecting it from both physical abuse and the stress of temperature extremes. The application of roof ballast in accordance with this guide will protect the underlying filter fabric and insulation from displacement during wind and rain storms. PMR systems should be installed in accordance with the recommendations of this guide, those of Dow's Protected Membrane Roofing Installation Guidelines and good roofing practice. The recommendations in this Guide have been derived from an extensive series of wind tunnel testing of ballasted roofing systems at the National Research Council of Canada and from relevant sections of ANSI/SPRI RP-4 "Wind Design Standard for Ballasted Singly-Ply Roofing Systems". This document first presents some General Design Considerations, then a series of tables from which the proper ballast design can be selected. The final section describes the requirements and alternatives of four recommended ballast designs. It is the responsibility of the design professional, and/or installer to ensure that the PMR system is appropriately designed for each building.

### General Design Considerations:

The following factors should be considered when designing a ballasted PMR system:

#### Roof Structure

It is imperative that the building structure be appropriately designed to support all anticipated present and future loads on the roof.

#### Slope

The roof slope shall not exceed 2-inch vertical rise per horizontal foot (2" in 12")

#### Design Wind Speed

Determination of design wind speed for buildings in Canada should reference Figure 1. Determination of design wind speed for USA should use Figures 2 or 3 depending on

ASCE 7 map version used in building design. In the USA and Canada the authority having jurisdiction (AHJ) may dictate design wind speed to be used. Care should be taken to confirm which design wind speed map the AHJ uses as reference.

#### Roof Height

A building may include numerous roof sections of different elevations. The height of each roof section is defined as the distance between ground level for that building section and the top of the ballast for that roof assembly.

#### Parapet Height

For the purpose of determining the appropriate ballast design, the parapet height shall be defined as the distance from the top of the ballast to the top of the parapet. If the height varies, the shortest parapet height should be used. For special cases, contact your Dow sales representative 1-866-583-BLUE (2583).

#### Gravel Stop

If a gravel stop is used at the building perimeter, its height above the ballast should be a minimum of 2" to contain the ballast.

#### Areas Requiring Extra Ballast

Roof perimeters, corner areas, and large roof penetrations require additional ballast to reduce potential displacement of ballast and/or insulation during high wind loads or intense rainfalls. The weight and dimensions of those increased ballast zones is specific to the type of Ballast System recommended. Tables A, B, C and D on pages 3 to 6 shall be used to determine the required Ballast System. The specifications for each Ballast System are outlined on page 5 of this document.

#### Building Exposure

The surrounding terrain has an effect on the overall wind exposure of the building. The exposure categories used for PMR systems are defined pursuant to ASCE-7 criteria; as either "B" or "C". Buildings in a "B" exposure are typically in urban areas with numerous, closely spaced obstructions having the size of a single family dwelling or larger. Buildings in

a “C” exposure are open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 ft. This category includes flat open country, grasslands, and all water surfaces in hurricane prone regions.

### Concrete Pavers

Concrete pavers shall be manufactured from minimum 3,000 psi concrete and whose minimum weight shall be determined by the Requirements of PMR Ballast Designs listed further in this document.

### Paver Venting

When pavers cover over 10 percent of the insulation surface, a 3/16” ventilating air space is required between the foam and the pavers to prevent freeze-thaw spalling of the concrete and potential moisture accumulation in the insulation. This air space can be achieved with paver pedestals, a 1” (25mm) layer of clean pea gravel or with ribbed or footed concrete pavers. In areas with less than 3,000 °F-days (1670 °C-days) heating degree days, the air space is not required. This air space is not required if the pavers are covering only a limited area, such as corners of the roof or narrow roof walkways.

### Paver Strapping

Strapping of pavers shall be accomplished with minimum 22 gauge, 3” wide x 12’ long galvanized or stainless steel straps. Strapping shall be mechanically fastened to each paver with minimum 1/4” x 1-1/4” corrosion-resistant metal anchors, installed in predrilled holes. For a list of recommended fasteners contact your sales representative or Dow at 1-866-563-BLUE (2583) or 1-800-363-6210 (French).

### Filter fabric

All ballast using stone or pavers shall be installed over an approved filter fabric. This fabric will prevent the migration of fine particles to the membrane level and prevent dislodgement of insulation boards in the event of roof flooding and floatation. For a list of acceptable filter fabrics contact Dow at 1-866-563-BLUE (2583) or your sales representative.

### Controlled-Flow Drain Systems and Blue Roof (Water Retention) Designs

Blue Roof Systems and Control Flow Drain Roof Systems are roofing system designs that control the drainage of rainwater, slowing its release rate into sewer systems mitigating the impact of water runoff. Depending on the intensity of rainfall, roof slope, drain flow characteristics, insulation thickness, and ballast weight the insulation may float once a threshold depth of water above the membrane is reached. As a guide, Table 1 shows the ballast required to prevent the insulation from floating. Please note that water-submerged ballast will lose approximately 40% of its effectiveness due to buoyant forces. This must be considered in the event the designer specifies the insulation remain in contact with the substrate.

**TABLE 1: Ballast Requirement to Prevent Floatation**

Insulation thickness in. (mm)	Ballast lb/ft <sup>2</sup> (kg/m <sup>2</sup> )
2.0 (50)	12.0 (60)
3.0 (75)	17.0 (83)
3.5 (90)	19.5 (95)
4.0 (100)	22.0 (108)
4.5 (115)	24.5 (120)
5.0 (125)	27.0 (132)
5.5 (140)	29.5 (145)
6.0 (150)	32.0 (156)
7.0 (175)	37.0 (180)
8.0 (200)	42.0 (206)
9.0 (225)	47.0 (230)

Caution: The additional load from heavy ballast and/or deep water retention over the roof structure needs to be examined by structural design professionals. Water retention roofs and control flow drain systems should be designed to allow evacuation of retained water within 48 hours of maximum accumulation.

### Ballast Design

#### Options

Selection of the Proper PMR Ballast Design:

A designer of PMR systems has four ballast designs to choose from: Standard, #1, #2 and #3. The appropriate design is function of building height, parapet height, membrane attachment and wind speed. Tables A, B, C and D are organized by membrane attachment method and building height, and list the ballast design that is required for each roof condition. Suitable designs are achieved by consulting the appropriate Table for the variables 1 to 5 below:

1. Roof membrane attachment
2. Building height
3. Design wind speed
4. Parapet height
5. Building site exposure

Find the proper ballast design. If paver ballast is to be used and will cover over 90 percent of the insulation, determine if paver venting is needed and, if so, how it will be accomplished.

Technical Solutions 508.2 provides guidance and installation recommendations for Dow™ Protected Membrane Roof assemblies. This document does not provide information for compliance verification with building codes, project specifications, Factory Mutual, or other agency requirements; which, is the sole responsibility of the design professional. As a supplier of material only, Dow does not assume responsibility for error in design and/or engineering.

### Warranties

Limited thermal and/or system warranties may be available. Please contact your sales representative to determine if warranties apply in your region.

**TABLE A: Membrane: Adhered**  
**Roof Heights: 12' (3.7m) to 45' (13.7m)**

A1 For 2" (.05m) gravel stops to 36" (0.90m) high parapets					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design	Standard	1	1	1	1
A2 For parapet heights > 36" (0.9m)					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design	Standard	Standard	Standard	Standard	Standard

**TABLE B: Membrane: Adhered**  
**Roof Heights: 45' (13.7m) to 70' (21.3m)**

B1 For 6" (.15m) gravel stops to 36" (0.90m) parapet heights					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design	Standard	1	1	1	1
B2 For parapet heights > 36" (0.9m)					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design	Standard	Standard	Standard	Standard	Standard

**TABLE C: Membrane: Adhered**  
**Roof Heights: 70' (21.3m) to 500' (152.5m)**

C1 For parapet heights 18" (.46 m) to 36" (.91m) (for lower parapets contact Dow)					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design, feet (m)					
> 70' – 100 ft' (> 21.3m – 31m)	1	1	2	2	2
> 100' - 200' (31m - 61m)	1	1	2	2	3
>200' - 300' (> 61m - 92m)	1	2	2	3	3
> 300' - 400' (> 92m - 122m)	1	2	2	3	NR
> 400' - 500' (> 122m - 152m)	1	2	2	3	NR

NOTE: For roofs above 500 ft (152 m) contact Dow at 1-866-583-2583  
 NR = Not Recommended

**TABLE C: Membrane: Adhered**  
**Roof Heights: 70' (21.3m) to 500' (152.5m)**

C2 For parapet heights > 36" (0.9m)					
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)				
	90 (40)	100 (45)	110 (48)	120 (54)	130 & 140 (58 & 63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)				
	115 (51)	130 (58)	140 (63)	155 (69)	270 & 290 (81 & 87)
Site Exposure	C&B	C&B	C&B	C&B	C&B
Ballast design, feet (m)					
> 70' – 100 ft' (> 21.3m – 31m)	Standard	1	1	1	1
> 100' – 200' (31m – 61m)	Standard	1	1	1	2
>200' – 300' (> 61m – 92m)	1	1	1	1	2
> 300' – 400' (> 92m – 122m)	1	1	1	2	2
> 400' – 500' (> 122m – 152m)	1	1	1	2	2

**TABLE D: Membrane: Loose-Laid Ballasted or Mechanically Attached**  
**Roof Heights: Up to 150 ft (46 m) max**

D1 For 2" (.05m) gravel stops to 5.9" (0.15m) high parapets						
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	1 S	1 1	1 1	2 2	NR 3
>15 – 30 (>4.6 – 9.1)	S S	1 S	1 1	1 1	2 2	NR 3
>30 – 60 (>9.1 – 18.3)	1 1	1 1	1 1	2 2	3 3	NR NR
>60 – 90 (>8.3 – 27.4)	2 2	2 2	2 2	3 3	NR NR	NR NR
>90 – 120 (>27.4 – 36.6)	2 2	2 2	3 3	NR NR	NR NR	NR NR
>120 – 150 (>36.6 – 46)	2 2	2 2	3 3	NR NR	NR NR	NR NR

D2 For parapets heights from 6" (0.015 m) to 11.9" (0.30 m)						
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	1 S	1 1	1 1	2 2	3 3
>15 – 30 (>4.6 – 9.1)	S S	1 S	1 1	1 1	2 2	3 3
>30 – 60 (>9.1 – 18.3)	1 1	1 1	1 1	2 2	3 3	NR 3
>60 – 90 (>8.3 – 27.4)	2 2	2 2	2 2	3 3	NR NR	NR NR
>90 – 120 (>27.4 – 36.6)	2 2	2 2	NR NR	NR NR	NR NR	NR NR
>120 – 150 (>36.6 – 46)	2 2	2 2	NR NR	NR NR	NR NR	NR NR

NOTE: For roofs above 500 ft (152 m) contact Dow at 1-866-583-2583  
 NR = Not Recommended

**D3 For parapets heights from 12" (0.30 m) to 17.9" (0.45 m)**

Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	S S	1 S	1 2	3 3	3 3
>15 – 30 (>4.6 – 9.1)	S S	1 S	1 1	1 2	3 3	3 3
>30 – 60 (>9.1 – 18.3)	1 S	1 1	1 1	2 2	3 3	NR 3
>60 – 90 (>8.3 – 27.4)	1 1	1 1	2 2	3 3	NR NR	NR NR
>90 – 120 (>27.4 – 36.6)	1 1	3 3	NR NR	NR NR	NR NR	NR NR
>120 – 150 (>36.6 – 46)	2 2	3 3	NR NR	NR NR	NR NR	NR NR

**D4 For parapets heights from 18" (0.45 m) to 23.9" (0.60 m)**

Design Wind Speed, when using Figures 1 & 2 maps	SCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	S S	S S	1 1	3 3	3 3
>15 – 30 (>4.6 – 9.1)	S S	S S	S S	1 1	3 3	3 3
>30 – 60 (>9.1 – 18.3)	1 S	1 1	1 1	2 2	3 3	3 3
>60 – 90 (>8.3 – 27.4)	1 1	1 1	1 1	3 3	NR 3	NR NR
>90 – 120 (>27.4 – 36.6)	1 1	2 2	2 2	NR NR	NR NR	NR NR
>120 – 150 (>36.6 – 46)	2 2	2 2	3 3	NR NR	NR NR	NR NR

**D5 For parapets heights from 24" (0.60 m) to 35.9" (0.91 m)**

Design Wind Speed, when using Figures 1 & 2 maps	SCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	S S	S S	1 1	3 3	3 3
>15 – 30 (>4.6 – 9.1)	S S	S S	S S	1 1	3 3	3 3
>30 – 60 (>9.1 – 18.3)	1 S	1 S	1 S	1 1	3 3	3 3
>60 – 90 (>8.3 – 27.4)	1 1	1 1	1 1	2 2	3 3	3 3
>90 – 120 (>27.4 – 36.6)	1 1	1 1	2 2	3 3	3 3	3 3
>120 – 150 (>36.6 – 46)	2 2	2 1	3 3	3 3	3 3	NR NR

D6 For parapets heights from 36" (0.91 m) to 71.9" (1.83 m)						
Design Wind Speed, when using Figures 1 & 2 maps	ASCE 7-05 Basic Wind Speed on 50 yr. return period – 3-sec gust - mph (m/s)					
	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Design Wind Speed, when using Figures 3 map	Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period – 3-sec gust - mph (m/s)					
	115 (51)	130 (58)	140 (63)	155 (69)	270 (81)	290 (87)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	S S	S S	1 1	3 3	3 3
>15 – 30 (>4.6 – 9.1)	S S	S S	S S	1 1	3 3	3 3
>30 – 60 (>9.1 – 18.3)	S S	1 S	1 S	1 1	3 3	3 3
>60 – 90 (>8.3 – 27.4)	S S	1 1	1 1	1 1	3 3	3 3
>90 – 120 (>27.4 – 36.6)	1 1	1 1	1 1	1 1	3 3	3 3
>120 – 150 (>36.6 – 46)	1 1	2 1	2 1	3 3	3 3	NR 3

D7 For parapets heights from 72" (1.83 m) to 96" (2.44 m)						
Design Wind Speed, mph (m/s)	90 (40)	100 (45)	110 (48)	120 (54)	130 (58)	140 (63)
Site Exposure	C B	C B	C B	C B	C B	C B
Ballast design, feet (m)						
0 – 15 (0 – 4.6)	S S	S S	S S	1 1	3 3	3 3
>15 – 30 (>4.6 – 9.1)	S S	S S	S S	1 1	3 3	3 3
>30 – 60 (>9.1 – 18.3)	S S	1 S	1 S	1 1	3 3	3 3
>60 – 90 (>8.3 – 27.4)	S S	1 1	1 1	1 1	3 3	3 3
>90 – 120 (>27.4 – 36.6)	1 1	1 1	1 1	1 1	3 3	3 3
>120 – 150 (>36.6 – 46)	1 1	2 2	2 2	2 2	3 3	3 3

NR -= Not Recommended

NOTES:

- For roofs above 150' (46m) contact Dow at 1-866-583-BLUE (2583) or 1-800-363-6210 (French)
- Table D assumes that proper provisions have been specified for sealing off openings in the roof deck and any perimeter blocking, to prevent air intrusion immediately below the roofing membrane and exerting "billowing" forces on the membrane.

## Requirements of PMR Ballast Designs

### Stone Ballast

All references to stone ballast herein are references to ASTM D448. Nominal ballast sizes, numbers, and associated sieve analyses are outlined below:

#### ASTM D448: Standard Size of Coarse Aggregate

Weight Percent Finer Than Sieve Openings								
Aggregate Nominal Size / #	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"
2-1/2" / # 2	100	90 to 100	35 to 70	0 to 10	–	0 to 5	–	–
1-1/2" / # 4		–	100	90 to 100	20 to 55	0 to 15	–	0 to 5
1" / # 5	–	–	–	100	90 - to 00	20 to 55	0 to 10	0 to 5

The following tables describe the requirements for each of the four PMR ballast designs identified in Tables A, B, C and D, including alternate designs and the corner paver array. Roof penetrations, perimeters, and corners requiring additional ballast are defined as follows:

**Perimeter Zones:** The perimeter zone is defined as the roof section parallel to the exterior roof edge at a minimum width of 8 feet.

**Corner Zones:** The corner zone is defined as the corner roof section where the perimeter zones intersect at a minimum dimension of 8-feet x 8-feet

**Field Zone:** The field zone is defined as the portion of the roof which is not included in the corner, perimeter, or penetration zones.

**Penetrations:** Penetrations are defined as any object projecting above the horizontal roof plane such as, but not limited to:

skylights, curbs, equipment platforms, and expansion joints that measure 4-feet or more on any side. The enhanced ballast area shall extend a minimum of 4-feet from all sides of the penetration, inclusive of any side that may not have a 4-foot dimension.

PMR Ballast Design: Standard*	
Field	Install 10 lb/ft <sup>2</sup> of #5 aggregate (1" stone). It may be crushed stone or rounded river bottom stone.
Perimeter	Install 15 lb/ft <sup>2</sup> of #5 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . As an alternate to either the 15 or 20 lb/ft <sup>2</sup> of stone ballast, 1 to 4 rows of 2'x2'x2" concrete pavers may be installed along the perimeter edge of the insulation with any remaining non-paver covered 8' perimeter zone ballasted with 15 or 20 lb/ft <sup>2</sup> stone.
Penetrations	Install 15 lb/ft <sup>2</sup> of #5 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . Alternately you may install 2'x2'x2" pavers for ballast around penetrations.
Corners	See Figure 4
Options to above	A minimum of 18 lb/ft <sup>2</sup> of concrete pavers may be installed over the entire roof. OR A minimum of 11 lb/ft <sup>2</sup> of proprietary interlocking concrete pavers (warranted by others) may be installed over the entire roof pursuant to the paver manufacturer's specifications.

PMR Ballast Design: #2*	
Field	Install 13 lb/ft <sup>2</sup> of #2 aggregate (2-1/2" stone). It may be crushed stone or rounded river bottom stone.
Perimeter	Install 15 lb/ft <sup>2</sup> of #2 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> .  As an alternate to either the 15 or 20 lb/ft <sup>2</sup> of stone ballast, 3 to 4 rows of 2'x2'x2" (minimum 6") concrete pavers may be installed along the perimeter edge of the insulation with any of the remaining non-paver covered 8' perimeter zone ballasted with 15 or 20 lb/ft <sup>2</sup> stone. The first row of perimeter edge pavers shall be strapped with straps running parallel to the parapet wall.
Penetrations	Install 15 lb/ft <sup>2</sup> of #2 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . Alternately you may install 2'x2'x2" pavers for ballast around penetrations.
Corners	See Figure 4
Options to above	A minimum of 22 lb/ft <sup>2</sup> of concrete pavers may be installed over the entire roof, with the first two rows of perimeter edge pavers strapped together, straps running parallel to the parapets. OR A minimum of 11 lb/ft <sup>2</sup> of proprietary interlocking concrete pavers (warranted by others) may be installed over the entire roof pursuant to the paver manufacturer's specifications.

PMR Ballast Design: #1*	
Field	Install 12 lb/ft <sup>2</sup> of #5 aggregate (1" stone). It may be crushed stone or rounded river bottom stone.
Perimeter	Install 15 lb/ft <sup>2</sup> of #4 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . As an alternate to either the 15 or 20 lb/ft <sup>2</sup> of stone ballast, 2 to 4 rows of 2'x2'x2", concrete pavers may be installed along the perimeter edge of the insulation with any of the remaining non-paver covered 8' perimeter zone ballasted with 15 or 20 lb/ft <sup>2</sup> stone.
Penetrations	Install 15 lb/ft <sup>2</sup> of #4 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . Alternately you may install 2'x2'x2" pavers for ballast around penetrations.
Corners	See Figure 4
Options to above	A minimum of 22 lb/ft <sup>2</sup> of concrete pavers may be installed over the entire roof. OR A minimum of 11 lb/ft <sup>2</sup> of proprietary interlocking concrete pavers (warranted by others) may be installed over the entire roof pursuant to the paver manufacturer's specifications.

PMR Ballast Design: #3*	
Field	Install 13 lb/ft <sup>2</sup> of #2 aggregate (2-1/2" stone) It may be crushed stone or rounded river bottom stone.
Perimeter	If applicable, adhere the membrane to the roof deck 4' from the parapets. Install four rows of 2'x2'x2" (8") concrete pavers along the perimeter edge of the insulation and strap the first two rows together, straps running parallel to the parapets.
Penetrations	Install 15 lb/ft <sup>2</sup> of #2 aggregate. If the STYROFOAM™ Brand insulation is 3" or more in thickness, install 20 lb/ft <sup>2</sup> . Alternately you may install 2'x2'x2" pavers for ballast around penetrations.
Corners	See Figure 4
Options to above	Minimum of 22 lb/ft <sup>2</sup> of concrete pavers may be installed over the entire roof, with the two rows of pavers nearest vwthe parapets strapped together, straps running parallel to the parapets. OR Minimum of 11 lb/ft <sup>2</sup> of proprietary interlocking concrete pavers (warranted by others) may be installed over the entire roof pursuant to the paver manufacturer's specifications.

\* Any ballast, stone, pavers or otherwise must be installed on a Dow-approved filter fabric. For a list of acceptable fabrics please contact your Dow Sales representative.





Source: CSA Standard C22.3 No. 1-01

The values shown are hourly mean wind speeds in mph at 10 m (32.8') above ground for terrain roughness category B. Mean 3-sec gust wind speeds can be obtained by multiplying hourly mean wind speed by 1.32.

Figure 1



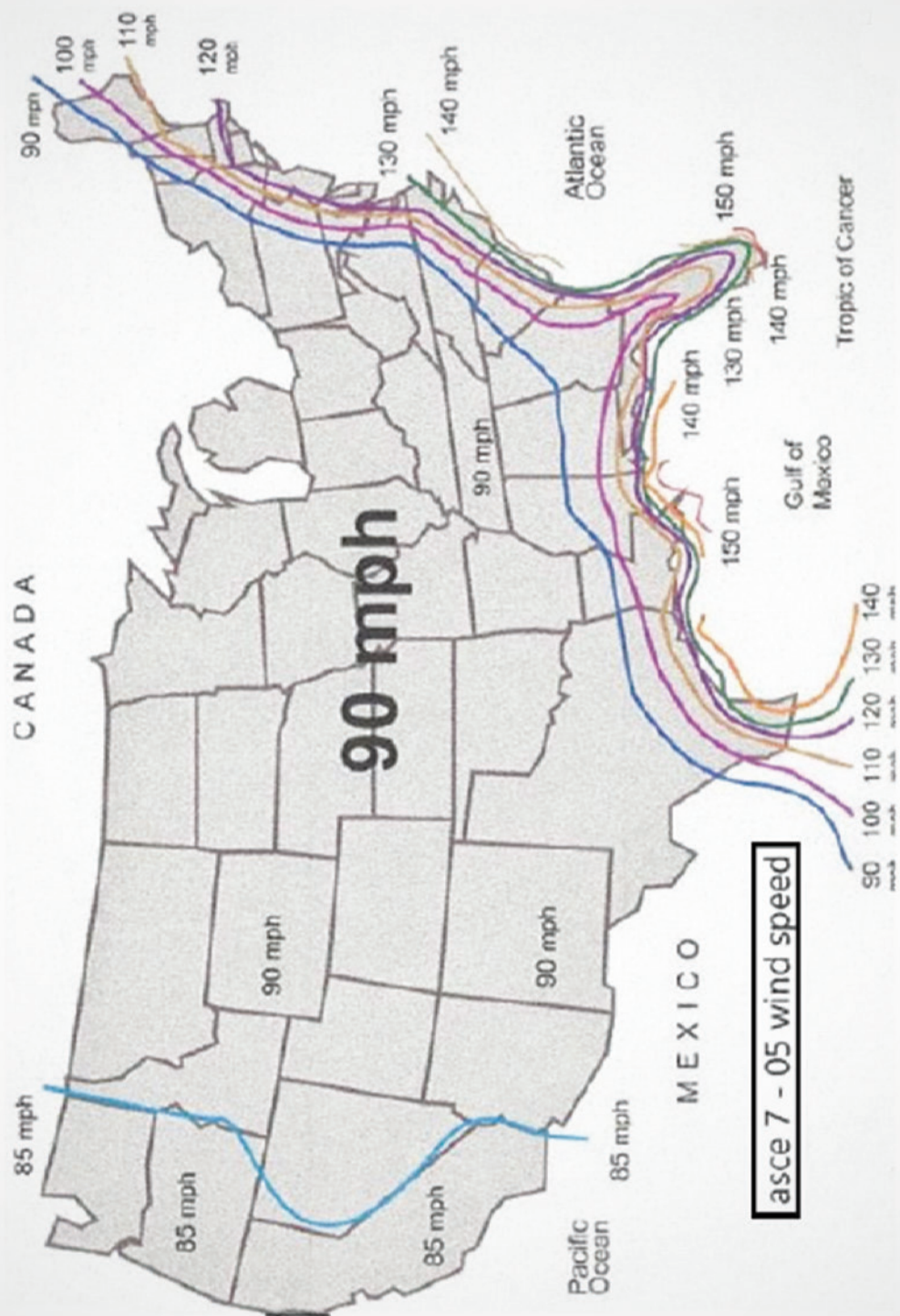


Figure 2



- Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (mph) at 33 ft (10m) above ground for Exposure C category.
  2. Linear interpolation between contours is permitted.
  3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
  4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
  5. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00333, MRI = 300 Years).

Figure 3

**Strapping :**

Minimum number of paver rows requiring strapping is outlined in Standard, #1, #2 and #3 PMR Ballast Design details

**Pavers:**

Minimum specified concrete paver rows are outlined in Standard, #1, #2 and #3 PMR Ballast Design details

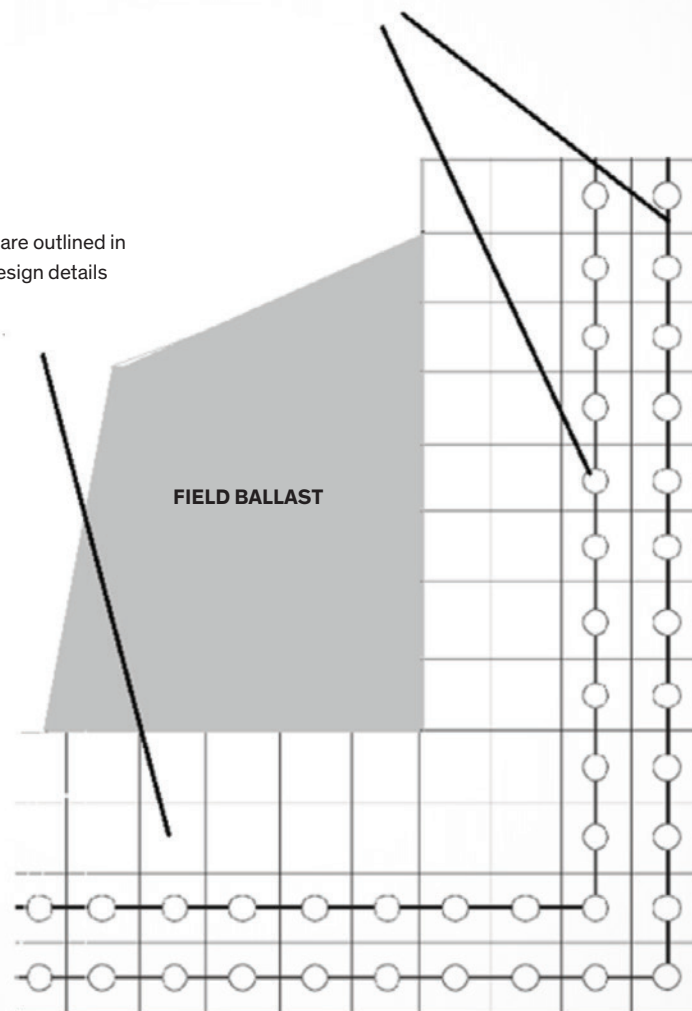


Figure 4

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